WHAT IS CLAIMED IS:

1. A power generator, comprising:

a rotor having a permanent magnet;

a stator and a magnetic core of soft magnetic material constituting a magnetic circuit; and

a coil wound around the magnetic core,

wherein the plate thickness d (m) of the soft magnetic material constituting at least one of the stator and the magnetic core is set at a value represented by the following formula of

$$d = \sqrt{\frac{k_h}{k_e}\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (1)$$

where k_h represents hysteresis loss coefficient, k_e represents eddy-current loss coefficient, ρ ($\Omega \cdot m$) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the soft magnetic material.

2. The power generator according to claim 1, wherein the soft magnetic material constituting at least one of the stator and the magnetic core is PC permalloy material, and the plate thickness d (m) of the PC permalloy material is set at a value represented by the following formula of

$$d = \sqrt{0.654\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (2)$$

where ρ ($\Omega \cdot m$) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the PC permalloy material.

3. The power generator according to claim 1, wherein the soft magnetic material constituting at least one of the stator and the magnetic core is Supermalloy material, and the plate thickness d (m) of the Supermalloy material is set at a value represented by the following formula of

$$d = \sqrt{0.137\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (3)$$

where ρ (Ω·m) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the Supermalloy material.

4. The power generator according to claim 1, wherein the soft magnetic material constituting at least one of the stator and the magnetic core is PD permalloy material, and the plate thickness d (m) of the PD permalloy material is set at a value represented by the following formula of

$$d = \sqrt{1.339\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (4)$$

where ρ (Ω·m) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the PD permalloy material.

5. The power generator according to claim 1 wherein the soft magnetic material constituting at least one of the stator and the magnetic core is PB permalloy material, and the plate thickness d (m) of the PB permalloy material is set at a value represented by the following formula of

$$d = \sqrt{3.049\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (5)$$

where ρ (Ω·m) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the PB permalloy material.

6. A power generator, comprising:

a rotor having a permanent magnet;

a stator and a magnetic core of soft magnetic material constituting a magnetic circuit; and

a coil wound around the magnetic core,

wherein the plate thickness d (m) of the soft magnetic material constituting at least one of the stator and the magnetic core is set within a plate thickness range determined so

that iron loss W does not exceed a reference value W_2, the reference value W_2 being obtained by a thickness d obtained in accordance with the following formula of

$$d = \sqrt{\frac{k_h}{k_e}\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (1)$$

where k_h represents hysteresis loss coefficient, k_e represents eddy-current loss coefficient, ρ (Ω·m) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the soft magnetic material, which is assigned to the following formula of

$$W \cong k_h d^{-1} B_m^{1.65} + k_e \frac{1}{\rho} d f^{0.75} B_m^2 \qquad (6)$$

to calculate a minimum value W_1 of the iron loss W (J/m^3), the reference value W_2 being set greater than the minimum value W_1.

7. The power generator according to claim 6, wherein the soft magnetic material constituting at least one of the stator and the magnetic core is PC permalloy material, and the plate thickness d (m) of the PC permalloy material is set within a plate thickness range determined so that iron loss W does not exceed a reference value W_2, the reference value W_2 being obtained by a thickness d obtained in accordance with the following formula of

$$d = \sqrt{0.654\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (2)$$

where ρ (Ω·m) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the PC permalloy material, which is assigned to the following formula of

$$W \cong 1.72 \times 10^{-3} d^{-1} B_m^{1.65} + 2.63 \times 10^{-3} \frac{1}{\rho} d f^{0.75} B_m^2 \qquad (7)$$

to calculate a minimum value W_1 of the iron loss W (J/m^3), the reference value W_2 being set 1.088 times as great as the minimum value W_1.

8. The power generator according to claim 6, wherein the soft magnetic material constituting at least one of the stator and the magnetic core is PC permalloy material, and the plate thickness d (m) of the PC permalloy material is set within a plate thickness range

determined so that iron loss W does not exceed a reference value W_2, the reference value W_2 being obtained by a thickness d obtained in accordance with the following formula of

$$d = \sqrt{0.654\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (2)$$

where ρ ($\Omega \cdot m$) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the PC permalloy material, which is assigned to the following formula of

$$W \cong 1.72 \times 10^{-3} d^{-1} B_m^{1.65} + 2.63 \times 10^{-3} \frac{1}{\rho} d f^{0.75} B_m^2 \qquad (7)$$

to calculate a minimum value W_1 of the iron loss W (J/m^3), the reference value W_2 being set 1.760 times as great as the minimum value W_1.

9. The power generator according to claim 6, wherein the soft magnetic material constituting at least one of the stator and the magnetic core is Supermalloy material, and the plate thickness d (m) of the Supermalloy material is set within a plate thickness range determined so that iron loss W does not exceed a reference value W_2, the reference value W_2 being obtained by a thickness d obtained in accordance with the following formula of

$$d = \sqrt{0.137\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (3)$$

where ρ ($\Omega \cdot m$) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the Supermalloy material, which is assigned to the following formula of

$$W \cong 0.36 \times 10^{-3} d^{-1} B_m^{1.65} + 2.63 \times 10^{-3} \frac{1}{\rho} d f^{0.75} B_m^2 \qquad (8)$$

to calculate a minimum value W_1 of the iron loss W (J/m^3), the reference value W_2 being set 2.355 times as great as the minimum value W_1.

10. The power generator according to claim 6,

wherein the drive source of the power generator is an oscillating weight rotated by an external force,

wherein the soft magnetic material constituting at least one of the stator and the

magnetic core is Supermalloy material, and the plate thickness d (m) of the Supermalloy material is set within a plate thickness range determined so that iron loss W does not exceed a reference value W_2, the reference value W_2 being obtained by a thickness d obtained in accordance with the following formula of

$$d = \sqrt{0.137\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (3)$$

where ρ (Ω·m) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the Supermalloy material, which is assigned to the following formula of

$$W \cong 0.36 \times 10^{-3} d^{-1} B_m^{1.65} + 2.63 \times 10^{-3} \frac{1}{\rho} d f^{0.75} B_m^2 \qquad (8)$$

to calculate a minimum value W_1 of the iron loss W (J/m^3), the reference value W_2 being set 3.634 times as great as the minimum value W_1.

11. The power generator according to claim 6,

wherein the soft magnetic material constituting at least one of the stator and the magnetic core is PD permalloy material, and the plate thickness d (m) of the PD permalloy material is set within a plate thickness range determined so that iron loss W does not exceed a reference value W_2, the reference value W_2 being obtained by a thickness d obtained in accordance with the following formula of

$$d = \sqrt{1.339\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (4)$$

where ρ (Ω·m) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the PD permalloy material, which is assigned to the following formula of

$$W \cong 23.58 \times 10^{-3} d^{-1} B_m^{1.65} + 2.63 \times 10^{-3} \frac{1}{\rho} d f^{0.75} B_m^2 \qquad (9)$$

to calculate a minimum value W_1 of the iron loss W (J/m^3), the reference value W_2 being set 3.634 times as great as the minimum value W_1.

SUB a1

12. The power generator according to any one of claims 1 to 11, wherein at least one

SUB a1 concl'd,

of the stator and the magnetic core is made of a single layer or a lamination of the soft magnetic material of the plate thickness d.

13. The power generator according to claim 12, wherein the soft magnetic material constituting at least one of the stator and the magnetic core has a lamination structure, and the respective layers forming the lamination structure have a minimum thickness of not less than 0.05mm.

SUB a2

14. An electronic device, comprising:

the power generator according to any one of claims 1 to 13; and

a processor actuated by the electric energy generated by the power generator.

15. An electronically controlled timepiece, comprising:

the power generator according to any one of claims 1 to 14; and

a processor for driving a time display by the electric energy generated by the power generator.

16. A method of setting plate thickness in a magnetic circuit in a power generator, the power generator including a rotor having a permanent magnet, a stator and a magnetic core made of a soft magnetic material constituting the magnetic circuit and a coil wound around the magnetic core,

wherein the plate thickness d is set at a value represented by the following formula of

$$d = \sqrt{\frac{k_h}{k_e}\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (1)$$

where k_h represents hysteresis loss coefficient, k_e represents eddy-current loss coefficient, ρ ($\Omega \cdot m$) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the soft magnetic material.

17. A method of setting plate thickness in a magnetic circuit in a power generator, the power generator including a rotor having a permanent magnet, a stator and a magnetic core made of a soft magnetic material constituting the magnetic circuit and a coil wound around the magnetic core,

wherein the plate thickness d is set within a plate thickness range determined so that iron loss W does not exceed a reference value W_2, the reference value W_2 being obtained by a thickness d obtained in accordance with the following formula of

$$d = \sqrt{\frac{k_h}{k_e}\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (1)$$

where k_h represents hysteresis loss coefficient, k_e represents eddy-current loss coefficient, ρ (Ω·m) represents resistivity, f (Hz) represents frequency and Bm (T) represents maximum amplitude magnetic flux density of the soft magnetic material, which is assigned to the following formula of

$$W \cong k_h d^{-1} B_m^{1.65} + k_e \frac{1}{\rho} d f^{0.75} B_m^2 \qquad (6)$$

to calculate a minimum value W_1 of the iron loss W (J/m^3), the reference value W_2 being set greater than the minimum value W_1.

18. The method of setting plate thickness in a magnetic circuit in a power generator according to claim 17, wherein the soft magnetic material constituting at least one of the stator and the magnetic core is PC permalloy material, and the plate thickness d (m) of the PC permalloy material is set within a plate thickness range determined so that iron loss W does not exceed a reference value W_2, the reference value W_2 being obtained by a thickness d obtained in accordance with the following formula of

$$d = \sqrt{0.654\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (2)$$

where ρ (Ω·m) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the PC permalloy material, which is assigned to the following formula of

$$W \cong 1.72 \times 10^{-3} d^{-1} B_m^{1.65} + 2.63 \times 10^{-3} \frac{1}{\rho} d f^{0.75} B_m^2 \quad (7)$$

to calculate a minimum value W_1 of the iron loss W (J/m^3), the reference value W_2 being set 1.088 times as great as the minimum value W_1 when a drive source of the power generator is not an oscillating weight rotated by an external force, and the reference value W_2 being set 1.760 times as great as the minimum value W_1 when a drive source of the power generator is an oscillating weight rotated by an external force.

19. The method of setting plate thickness in a magnetic circuit in a power generator according to claim 17, wherein the soft magnetic material constituting at least one of the stator and the magnetic core is Supermalloy material, and the plate thickness d (m) of the Supermalloy material is set within a plate thickness range determined so that iron loss W does not exceed a reference value W_2, the reference value W_2 being obtained by a thickness d obtained in accordance with the following formula of

$$d = \sqrt{0.137\rho} \cdot f^{-0.375} B_m^{-0.175} \quad (3)$$

where ρ (Ω·m) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the Supermalloy material, which is assigned to the following formula of

$$W \cong 0.36 \times 10^{-3} d^{-1} B_m^{1.65} + 2.63 \times 10^{-3} \frac{1}{\rho} d f^{0.75} B_m^2 \quad (8)$$

to calculate a minimum value W_1 of the iron loss W (J/m^3), the reference value W_2 being set 2.355 times as great as the minimum value W_1 when a drive source of the power generator is not an oscillating weight rotated by an external force, and the reference value W_2 being set 3.634 times as great as the minimum value W_1 when a drive source of the power generator is an oscillating weight rotated by an external force.

20. The method of setting plate thickness in a magnetic circuit in a power generator according to claim 17, wherein the soft magnetic material constituting at least one of the stator and the magnetic core is PD permalloy material, and the plate thickness d (m) of the PD permalloy material is set within a plate thickness range determined so that iron loss W does not exceed a reference value W_2, the reference value W_2 being obtained by a thickness d obtained in accordance with the following formula of

$$d = \sqrt{1.339\rho} \cdot f^{-0.375} B_m^{-0.175} \qquad (4)$$

where ρ ($\Omega \cdot m$) represents resistivity, f (Hz) represents frequency and B_m (T) represents maximum amplitude magnetic flux density of the PD permalloy material, which is assigned to the following formula of

$$W \cong 23.58 \times 10^{-3} d^{-1} B_m^{1.65} + 2.63 \times 10^{-3} \frac{1}{\rho} d f^{0.75} B_m^2 \qquad (9)$$

to calculate a minimum value W_1 of the iron loss W (J/m^3), the reference value W_2 being set 2.72 times as great as the minimum value W_1.

21. The method of setting plate thickness in a magnetic circuit in a power generator according to claim 17, wherein, for the plate thickness d exhibiting the minimum value W_1 and a total thickness D required for the stator or the magnet core, when the plate thickness d exceeds the total thickness D, a single-layer structure of the thickness D is used, and when the thickness d is smaller than the total thickness D, a lamination structure of a plurality of plate materials including a layer of the plate thickness d is used.

22. The method of setting plate thickness in a magnetic circuit in a power generator according to claim 17, wherein a first plurality of combinations of a plurality of plate materials including a layer of the thickness d exhibiting the minimum value W_1 are set in constructing the lamination structure and a combination among the first plurality of combinations exhibiting the iron loss W not more than the reference value W_2 is adopted when there is the combination exhibiting the iron loss not more than the reference value W_2 in the first combinations, and, when there is no combination exhibiting the iron loss not more than the reference value W_2 in the first combinations, a second plurality of combinations of a plurality of plate materials of total thickness D including a layer of iron loss greater than the layer of the plate thickness d are set and a combination among the second plurality of combinations exhibiting the iron loss W not more than the reference value W_2 is adopted when there is the combination exhibiting the iron loss not more than the reference value W_2 in the second combinations.

Sub B3

23. The method of setting plate thickness in a magnetic circuit in a power generator according to claim 21 or 22,

Sub a3 cond'd.

wherein the soft magnetic material constituting at least one of the stator and the magnetic core has a lamination structure and the respective layers forming the lamination structure have a minimum thickness of not less than 0.05mm.

add a4